UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/866,090	05/25/2001	Thomas J. Ball	50037.58US01	5480

27488 7590 10/05/2004

MICROSOFT CORPORATION
C/O MERCHANT & GOULD, L.L.C.
P.O. BOX 2903
MINNEAPOLIS, MN 55402-0903

EXAMINER	
VO, TED T	

ART UNIT	PAPER NUMBER
2122	

DATE MAILED: 10/05/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/866,090	BALL ET AL.
	Examiner	Art Unit
	Ted T. Vo	2122

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 May 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-56* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-56* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☒ The oath or declaration is objected to by the Examiner. ~~Note the attached Office Action or form PTO-152~~.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This action is in response to the application filed on 5/25/2001.

Claims 1-56 are pending in the application.

Oath/Declaration

2. The Oath/Declaration filed on 5/25/01 is objected to. It does not state that the person making the oath or declaration acknowledges the duty to disclose to the Office all information known to the person to be material to patentability as defined in 37 CFR **1.56**.

Claim Rejections - 35 USC § 101

3. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

4. The claims 1-5, 6-10, 11-15, 16-20, 26-39, 40-44, 45-56 are rejected under 35 U.S.C 101 because the claimed invention is directed to non-statutory subject matter.

As per claims 1-5: Claims 1-5 are claiming *A system for analyzing a program having multiple statements,* which is led by claim 1, where,

Claim 1 recites the limitations that fail to cause the system to be tangible. The system as recited could be identified as being implemented in a paper since the lack of hardware tangibility. Such claim fails to be in the technological or useful arts and thus fails to recite patent eligible subject matters.

Claims 2-5 fail to remedy the deficiencies of independent Claim 1.

- According to the analysis above, claims 1-5 are claiming a system that is not tangible in computer hardware for causing the computer to execute in a practical manner. The claims 1-5 thus are manipulating an abstract idea and held nonstatutory.

As per claims 6-10: Claims 6-10 are claiming *A system for analyzing a program having multiple statements,* which is led by Claim 6, where,

Claim 6 recites the steps that could be implemented by using pens and papers. The system fails to be indicated as an executable system, and the steps fail to show as to be tangibly executed by such a system. Such claim fails to be in the technological or useful arts and thus fails to recite patent eligible subject matters.

Claims 7-10 fail to remedy the deficiencies of independent Claim 6.

- According to the analysis above, claims 6-10 are claiming a method that is not tangible in computer hardware for causing the computer to execute in a practical manner. The claims 6-10 thus are manipulating an abstract idea and held nonstatutory.

As per claims 11-15: Claims 11-15 are claiming *A method for analyzing a program,* which is led by Claim 11, where,

Claim 11 recites the steps that could be implemented by using pens and papers. The steps fail to cause the method to be tangibly executed by a hardware system. Such claim fails to be in the technological or useful arts and thus fails to recite patent eligible subject matters.

Claims 12-15 fail to remedy the deficiencies of independent Claim 11.

- According to the analysis above, claims 11-15 are claiming a method that is not tangible in computer hardware for causing the computer to execute in a practical manner. The claims 11-15 thus are manipulating an abstract idea and held nonstatutory.

As per claims 16-20: Claims 16-20 are claiming *A method for checking a model of a program,* which is led by Claim 16, where,

Claim 16 recites the steps that could be implemented by using pens and papers. The steps fail to cause the method to be tangibly executed by a hardware system. Such claim fails to be in the technological or useful arts and thus fails to recite patent eligible subject matters.

Claims 17-20 fail to remedy the deficiencies of independent Claim 16.

- According to the analysis above, claims 16-20 are claiming a method that is not tangible in computer hardware for causing the computer to execute in a practical manner. The claims 16-20 thus are manipulating an abstract idea and held nonstatutory.

As per claims 26-39: Claims 26-39 are claiming *A method for checking a model of a program,* which is led by Claim 26, where

Claim 26 recites the steps that could be implemented by using pens and papers. The steps fail to cause the method to be tangibly executed by a hardware system. Such claim fails to be in the technological or useful arts and thus fails to recite patent eligible subject matters.

Claims 27-39 fail to remedy the deficiencies of independent Claim 26.

- According to the analysis above, claims 26-39 are claiming a method that is not tangible in computer hardware for causing the computer to execute in a practical manner. The claims 26-39 thus are manipulating an abstract idea and held nonstatutory.

As per claims 40-44: Claims 40-44 are claiming *A method for generating a trace for a model of a program,* which is led by Claim 40, where

Claim 40 recites the steps that could be implemented by using pens and papers. The steps fail to cause the method to be tangibly executed by a hardware system. Such claim fails to be in the technological or useful arts and thus fails to recite patent eligible subject matters.

Claims 41-44 fail to remedy the deficiencies of independent Claim 40.

- According to the analysis above, claims 40-44 are claiming a method that is not tangible in computer hardware for causing the computer to execute in a practical manner. The claims 41-44 thus are manipulating an abstract idea and held nonstatutory.

As per claims 45-56: Claims 45-56 are claiming *A method for generating a trace for a model of a program,* which is led by Claim 45, where

Claim 45 recites the steps that could be implemented by using pens and papers. The steps fail to cause the method to be tangibly executed by a hardware system. Such claim fails to be in the technological or useful arts and thus fails to recite patent eligible subject matters.

Claims 46-56 fail to remedy the deficiencies of independent Claim 45.

- According to the analysis above, claims 45-56 are claiming a method that is not tangible in computer hardware for causing the computer to execute in a practical manner. The claims 45-56 thus are manipulating an abstract idea and held nonstatutory.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-5, 40-41 are rejected under 35 U.S.C. 102(b) as being anticipated by Larus et al., "Optimal Profiling and Tracing Program", ACM 1994.

As per Claim 1: Larus discloses, "*A system for analyzing a program having multiple statements, comprising: a graph generator that uses a model of the program to generate a control-flow graph* (Page 5, see Figure 1)*; and*

an analyzer to analyze each vertex of the control-flow graph to determine the reachability of each statement in the program (Page 22, Figure 15), *and wherein the analyzer forms an implicit representation of values of variables at each vertex so as to inhibit computational explosion* (Page 22, see DEFINITION, where v: vertex, $v=x_n$)".

As per Claim 2: Larus discloses, "*The system of claim 1, wherein the analyzer uses a set of binary decisions diagrams to implicitly represent values of variables*" (Page 30, see Figure 18).

As per Claim 3: Larus discloses, "*The system of claim 1, further comprising a summarizer to summarize each procedure in the model such that the analyzer need not analyze a procedure if the procedure was previously analyzed* (Page 29, See table 2, a typical summary of procedures).

As per Claim 4: Larus discloses, "*The system of claim 1, further comprising a trace generator to generate a trace to a vertex that is reachable, wherein the trace includes a shortest trace to the vertex that is reachable*" (Page 28, See section 6.2 "Tracing Performance", and in page 22, see Figure 15).

As per Claim 5: Larus discloses, "*The system of claim 1, further comprising an optimizer to optimize a size of the implicit representation to enhance the analyzer*" (Page 30, see section 6.3 "Optimizations").

As per Claim 40: Larus discloses, "*A method for generating a trace for a model of a program, comprising:*

forming a control-flow graph having vertices from the model; (See Control-flow graphs in Figure 1, page 5);

applying a transfer function to each vertex to form a set of path edges; (Page 15, g(f), freqn());

analyzing the set of path edges of a vertex (Page 15, Figure 10; page 22, Figure 15)*; and*

tagging a unit length that the trace takes to reach the vertex from another vertex" (Page 22, see Figure 15, see each vertex, for example blockers B, I, H).

As per Claim 41: Larus discloses, "*The method of claim 40, iterating the act of applying, analyzing, and tagging so as to form at least one trace to a vertex that is reachable in the model, wherein the at least one trace includes multiple unit lengths that form a length of the at least one trace*" (Page 22, see Figure 15, and the DEFINITION).

7. Claims 6-27, 45-46, 53 are rejected under 35 U.S.C. 102(b) as being anticipated by Ball et al., "On The Limit of Control Flow Analysis for Regression Test Selection", ACM 1998.

As per Claim 6: Ball discloses, "*A method for analyzing a program having multiple statements, comprising: labeling a statement of the multiple statements with a label* (Page 6, see Figure 4, referring to vertex labels: A, B, C...etc.);
determining whether the label is reachable (Page 5, Figure 3); *and providing a shortest trace to the label from the first line of the program if the label is determined to be reachable* (Page 5, Figure 3; and see page 8-9, section 5: CRTS Using Path Coverage).

As per Claim 7: Ball discloses, "*The method of claim 6, wherein providing includes displaying a depth of a call stack of the program and identifying the call stack at each point in the trace*" (Page 8, see Figure 6, and right column, second full paragraph, "see depth-first search from s").

As per Claim 8: Ball discloses, "*The method of claim 7, wherein displaying includes displaying a state of each variable of the program that is in scope*" (Page 8, Figure 6, "t" or "f").

As per Claim 9: Ball discloses, "*The method of claim 6, wherein providing includes displaying an initial value of a variable of the program in order for the label to be reachable* " (Page 3, Figure 1 - G").

As per Claim 10: Ball discloses, "*The method of claim 6, wherein providing includes displaying whether a value of a variable in the program would change due to a call to a procedure in the program.*" (Page 8, Figure 6, "t" and "f" and a node/label in the control-flow graph represent a procedure).

As per Claim 11: Claimed limitation has the functionality corresponding to Claim 6. Claim 11 is rejected in the same reason as set forth in Claim 6.

As per Claim 12: Ball discloses, "*The method of claim 11, wherein determining includes computing a summary that records a behavior of a procedure* (See Figure 4, as an example of a computing behavior summary on a subroutine), *wherein the summary includes a set of output produced from the procedure for a set of input given to the procedure* (See definitions of sets such as I(G,G') in section 4.2, or 4.3).

As per Claim 13: Ball discloses, "*The method of claim 11, wherein determining includes checking the model based on an algorithm, wherein the complexity of the algorithm in time and space is proportional to a number of edges multiplied by 2 to the power of k, wherein k defines the maximal number of variables in scope at any point in the program, and wherein the number of edges are edges in a control-flow graph of the model*" (Page 4, Section 4, refer to number of subset Pp of D(G,G') or I(G,G'); and see footnote 6).

As per Claim 14: Ball discloses, "*The method of claim 11, wherein determining includes determining using an explicit control-flow graph* (See Figures with Control flow graphs).

As per Claim 15: Ball discloses, "*The method of claim 14, wherein determining includes optimizing the model* (All Figures with Control flow graphs are illustrated for optimizing).

As per Claim 16: Ball discloses, "*A method for checking a model of a program, comprising: forming a control-flow graph having vertices from the model* (See page 3, Figure 1-G)*; applying a transfer function to a vertex to form a set of path edges* (See page 3, referring to D(G,G'), I(G,G'))*;*
and analyzing the set of path edges of a vertex (A(t), A(f))*, wherein the set of path edges includes valuations that are implicitly represented so as to inhibit an undesired explosion in the valuations that would hinder the act of analyzing* (See page 8, definition of path p; for example p1, p2, p3, p4 in section 5).

As per Claim 17: Ball discloses, "*The method of claim 16, further comprising iterating the act of applying and the act of analyzing until the act of iterating is terminated by an act of terminating* (See whole section 5, pages 8-9: base on each successor vertex, path until the end in the graph, for example p1 →, p2 →, p3, then *analyzing until* p4).

As per Claim 18: Ball discloses, "*The method of claim 17, further comprising concluding that the vertex is unreachable if the set of path edges of the vertex is empty upon the execution of the act of terminating* (See Section 3: Based on the set D(G,G'): Vertex reject represents the reject state or I(G,G'): Vertex accept represents the accept state).

As per Claim 19: Ball discloses, "*The method of claim 17, further comprising concluding that the vertex is reachable if the set of path edges of the vertex is not empty upon the execution of the act of terminating*

(See Section 3: Based on the set D(G,G'): Vertex reject represents the reject state or I(G,G'): Vertex accept represents the accept state).

As per Claim 20: Ball discloses, "*The method of claim 19, further comprising generating a trace to the vertex if the act of concluding concludes that the vertex is reachable, wherein the trace is the shortest trace from the beginning of the model to the vertex* (For example, see page 8, section 5, the path p in I(G,G')).

As per Claims 21-25: With regards to the limitations of Claims 21-25, Claims have the limitations corresponding to the limitations of Claims 16-20. Claims 21-25 have the same rejections as given in Claims 16-20.

As per Claim 26: Regarding limitation: "*A method for checking a model of a program, comprising: receiving a graph having a set of vertices and a successor function; initializing sets of path edges, sets of summary edges, and a work list; removing a vertex having a type from the work list; and analyzing the vertex based on the type so as to determine the reachability status of the vertex in the set of vertices, wherein analyzing includes updating a set of path edges associated with the vertex by using a transfer function associated with the vertex.*", Claim has the functionality in the same manner with Claim 16. See rationale in Claim 16.

As per Claim 27: Regarding limitation: "*The method of claim 26, further comprising iterating at least two acts, wherein the at least two acts include the act of removing to remove another vertex from the work list and the act of analyzing to analyze the another vertex, wherein the act of iterating iterates until the work list is empty.*" (See the analysis of steps (1), (2), (3), (4): For example, it starts with s then with w).

As per Claim 45: Ball discloses, "*A method for generating a trace for a model of a program, comprising: forming a set of rings associated with each vertex of the model; finding a ring such that a set of path edges of a reachable vertex exists* (See page 8, set of p1, p2, p3, p4 in right column); *and analyzing the reachable vertex based on a type of the reachable vertex so as to generate a trace from the entry of the main procedure of the program to the reachable vertex.*" (See Figures, 4,5,5, "reject", "Accept", see definition of I(G,G'), and se a path p in I(G,G'): particularly, an example of p1,p2,p3,p4 in page 8 in right column).

As per Claim 46: Ball discloses, "*The method of claim 45, wherein analyzing includes analyzing two cases if the reachable vertex is not an index of the first statement in a procedure containing the reachable vertex* (See page section 4.4 The Valid-reachable Algorithm: An Edge-optimal Algorithm. 8, right column, Depth-first search).

As per Claim 53: Ball discloses, "*The method of claim 45, wherein analyzing includes analyzing a predecessor vertex of the reachable vertex if the reachable vertex is an index of the first statement in the procedure containing the reachable vertex, wherein a statement associated with the predecessor vertex is a call to a procedure containing the reachable vertex*", by providing reachability Algorithm in sections 4.2, 4.3, and 4.4, and depth-first search (page 8, right column).

Allowable Subject Matter

8. Claims 28-39, 42-44, 47-52, 54-56 are dependent upon the rejected base claims addressed above.

Note: Claims 28-39, 42-44, 47-52, 54-56 remain rejected under 35 U.S.C 101 above.

As per Claims 28-29, 42, 47, 50, 54-55: The Claims are objected to under their rejected base claims 26, 40, and 45, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, provided with the amendments that overcome the rejection under 101 statutory above.

Prior of record Larus, or prior of record Ball taken alone or in combination fail to teach further limitations comprising at least features:

"initializing includes setting each set of the sets of path edges to the empty set, wherein each set of the sets of path edges is associated with a vertex in the set of vertices, wherein initializing includes setting each set of the sets of summary edges to the empty set, wherein each set of the summary edges is associated with a vertex in a set of call vertices, wherein the set of call vertices is a subset of the set of vertices that represents call statements in the program", as recited in such manner in Claim 28;

"*receiving a vertex argument and a path edge argument, forming a union of the set of path edges associated with the vertex argument and the path edge argument if the path edge argument is not a subset of the set of path edges associated with the vertex argument, and inserting the vertex argument into the work list*", as recited in such manner in Claim 29;

"*finding a shortest trace having a length, wherein the shortest trace is a subset of the at least one trace, wherein finding includes finding a predecessor vertex that has the length minus a unit length and iterating the act of finding the predecessor to find another predecessor vertex that has the length minus an additional unit length until no predecessor vertex can be found.*", as recited in such manner in Claim 42;

"*analyzing one of the two cases if a statement of the reachable vertex is not a skip statement immediately following a procedure call, wherein analyzing includes finding a predecessor vertex of the reachable vertex such that two conditions exist", as* recited in such manner in Claim 47;

"*analyzing the other of the two cases if a statement of the reachable vertex is a skip statement immediately following a procedure call, wherein analyzing includes finding a predecessor vertex of the reachable vertex such that two conditions exist* ", as recited in such manner in Claim 50;

"*finding the predecessor vertex and lifting a valuation associated with the reachable vertex to a path edge in the set of path edges associated with the predecessor vertex*", as recited in such manner in Claim 54;

and so as,

"*finding a predecessor vertex according to two conditions, wherein one of the two conditions includes that the predecessor vertex be an element of a set of call vertices, and wherein the other of the two conditions includes an existence of a path edge to the predecessor vertex in the set of path edges associated with the predecessor vertex at a ring one unit less than the ring of the reachable vertex*", as recited in such manner in Claim 55;

As per Claims 30-39, 43-44, 48-49, 51-52, 56: Under the allowable subject matters, the Claims are objected to because of being dependent upon the claims that are objected to.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Robison, US No. 5,805,894, discloses a method for analyzing and optimizing programs by predicting branches and redirecting control flow.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ted T. Vo whose telephone number is (703) 308-9049. The examiner can normally be reached on 8:00AM to 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (703) 305-4552. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

After October 25, 2004, examiner can be reached at new telephone number (571) 272-3706 and the examiner's supervisor, Tuan Q. Dam can be reached on (571) 272-3694.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TED T. VO

TTV
Patent Examiner
Art Unit 2122
September 30, 2004